



NASA Glenn Research Center Technology Showcase

Sensors and Electronics

High Temperature SiC Electronics
Dr. Philip G. Neudeck

A vertical banner for the NASA Glenn Research Center Technology Showcase. It features a colorful bar at the top with vertical stripes in green, yellow, blue, purple, and orange. Below this, the text "NASA Glenn Research Center" is in a white box, followed by "TECHNOLOGY SHOWCASE" in large white letters. Underneath are five categories: "Materials and Structures" (Materials and Structures), "Biomedical" (Biomedical), "Sensors and Electronics" (Sensors and Electronics), "Advanced/ Alternative Energy" (Advanced/ Alternative Energy), and "Advanced Propulsion" (Advanced Propulsion). Each category has a small image: Materials and Structures shows a hand holding a white sphere; Biomedical shows a person in a lab coat; Sensors and Electronics shows a close-up of a circuit board; Advanced/ Alternative Energy shows a green leaf; and Advanced Propulsion shows a rocket engine. At the bottom, the date "December 2, 2011" and location "Cleveland Airport Marriott Hotel" are listed.



High Temperature SiC Electronics

This technology/capability is...

- Integrated circuit chips and packaging that operate reliably at +500 °C for thousands of hours (unique achievement).
- Integrated circuit chips that operate from -100 °C through +500 °C WITHOUT changing input/output signal voltages (unique achievement).
- This innovation enables needed electronic sensing and control functionality to be placed directly where needed/beneficial in very harsh environments WITHOUT cooling/shielding/wiring overhead penalty.
- Chips are made using silicon carbide junction field effect transistors (SiC JFET) instead of silicon metal-oxide-semiconductor field effect transistors (Si MOSFET).



High Temperature SiC Electronics

Potential applications may include ...

- Combustion engine sensing and control for improved fuel efficiency and reduced pollution (jet engines and automotive engines).
- Electrical power plant control (fossil fuel combustion & advanced nuclear)
- Deep-well drilling telemetry for energy production (oil, gas, & geothermal)
- High temperature manufacturing process sensing and control
- Harsh-environment robotics (scientific exploration and firefighting)



High Temperature SiC Electronics

Key benefits are ...

- **Capability**: provides durable integrated circuit electronics functionality to much harsher (previously unattainable 300 °C to 500 °C) environments, but also work at lower temperatures (down to -100 °C).
- **Simplicity**: eliminates active cooling hardware, wires, shielding, and/or connectors previously needed for harsh-environment electronic sensing and control implementation.
- **Small**: complex integrated circuit chips are inherently very small and lightweight which enables insertion without adverse impact to system size.
- **Customizable**: application-specific integrated circuits (ASICs) can be designed and implemented to meet specific needs of various customers.
- **Mass-fabrication**: hundreds of chips manufactured in parallel on each SiC wafer via available semiconductor industry manufacturing tools and methods.

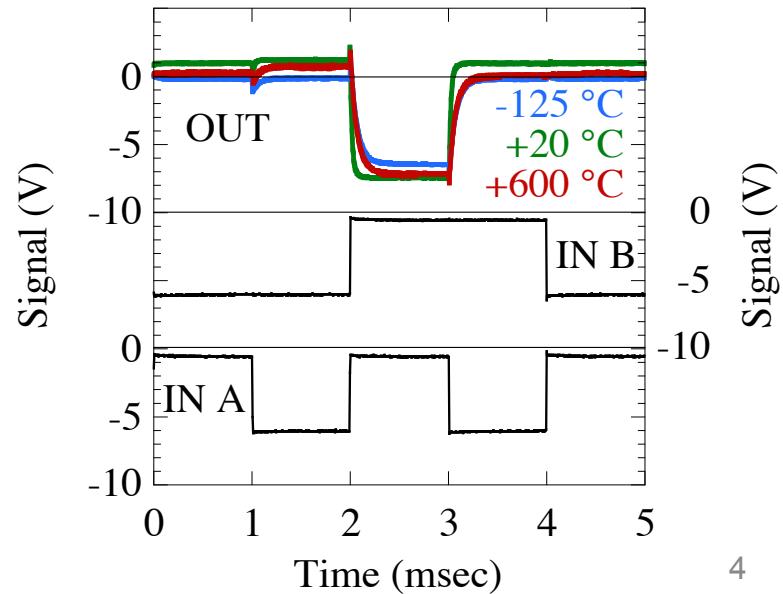
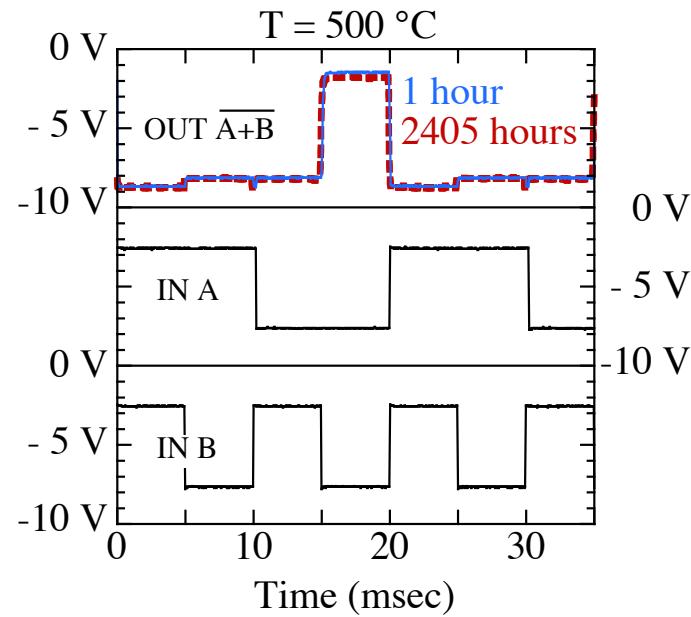


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Technical details ...

State of development of the technology – Simple prototypes demonstrated (logic gates, amplifier stages), presently developing more complicated prototypes (operational amplifiers, Analog/Digital converters)

Test results – environmental chamber testing of simple logic gates





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TECHNOLOGY SHOWCASE



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Point of contact ...

Dr. Philip G. Neudeck
Neudeck@nasa.gov
(216) 433-8902



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QA

What questions do you have at this point?

Thank You
for your time and attention!